DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
Office of Flexible Pavement Materials
5900 Folsom Blvd.
Sacramento, California 95819-4612

LABORATORY PROCEDURE FOR TREATING DAMP AGGREGATE WITH DRY LIME FOR ASPHALT CONCRETE MIX DESIGN

SCOPE

This protocol provides a laboratory procedure for treating damp aggregate with dry hydrated lime, with or without marination, for use in asphalt concrete mix design.

APPARATUS

1. *Balance* - Accurate to 0.1 g.

2. *Plastic Containers* – One liter with watertight lids for storing materials.

3. *Graduated cylinder* - 100 ml

4. *Small round tins* – approximately 70 mm diameter x 48 mm deep.

5. *Oven and equipment from California Test 304* - for preparation of design set.

6. *Miscellaneous Apparatus and Tools* – Trowel or spoon, stopwatch or timer, heat resistant gloves and safety glasses or goggles.

MATERIALS

1. Aggregate

    a. If marination is used, coarse aggregate and fine aggregate stockpiles proposed for use on the project shall be treated and marinated separately. Coarse aggregate stockpiles contain more than 50 percent material retained on the 4.75 mm sieve. Fine aggregate stockpiles contain less than or equal to 50 percent material retained on the 4.75 mm sieve.
    b. If marination is not used, the combined aggregate shall be treated.

2. Lime - Lime shall be a high-calcium hydrated lime that conforms to the provisions in Section 24-1.02, “Materials,” of the Standard Specifications.

3. Water - Water shall be free from oil and other impurities and shall contain not more than 650 parts per million of chlorides (Cl) and not more than 1300 parts per million of sulfates (SO_4).

PROCEDURE FOR AGGREGATE TREATMENT WITHOUT MARINATION

1. Combine oven-dry samples of all the aggregate in accordance with California Test 304 and allow to cool to room temperature.

   NOTE: The combined aggregate gradation shall include the lime.

2. Weigh-out individual lime batches in the small round tins. (Example: 18 g in each tin provides 1.5% lime content for each 1200 g batch of dry aggregate.)

   NOTE: The Contractor, as part of the mix design process, shall determine the exact proportion of lime. The combined aggregate shall contain not less than 0.8 percent and not more than 1.5 percent lime by mass of dry aggregate. The amount of lime for open graded asphalt concrete may be reduced to between 0.5 percent and 1.0 percent.

3. Place the combined aggregate batch in the mixing bowl.

4. Calculate the proportional combined saturated surface dry (SSD) moisture content to be used when lime treating the aggregate samples. Using the calculated SSD moisture content for the combined sample, calculate an additional 2 percent based on dry mass of the combined aggregate, and add the total water (SSD plus 2 percent) to the combined aggregate in the mixing bowl.

5. Using a mechanical mixer or trowel or spoon, mix the aggregate and total water for a minimum of 2 minutes or until moisture is uniformly distributed throughout the aggregate sample.

6. Remove the moisture conditioned sample from the mixing bowl being careful to remove all material from the mixing bowl and place in a covered container for 30 minutes prior to the addition of the lime.

7. Place the moisture conditioned combined aggregate in the mixing bowl and add the pre-determined lime batch and mechanically mix or hand mix for a period of 2 minutes.

8. After mixing, remove the lime treated combined aggregate and place in suitable drying pans. Oven dry the lime-treated aggregate to a constant weight at the compaction temperature specified in California Test 304 and proceed with the mix design.

NOTE: If fine particles or lime residue sticks to the pan after drying, use a short bristle brush to remove the particles or residue and recombine the material with the rest of the sample.

NOTE: Aggregate shall not be re-treated with lime once it has been treated.

PROCEDURE FOR AGGREGATE TREATMENT WITH MARINATION

1. Add 2 percent water by dry weight of aggregate to each coarse and fine aggregate stockpile sample and mix thoroughly.

   NOTE: The moisture content of the aggregate shall be 2 percent by dry weight of the aggregate before mixing with dry lime. If the aggregate readily absorbs the moisture, additional water may be added to assure complete coating of aggregate particles with lime.

2. Determine the mass of lime required to provide the desired content, by dry mass of aggregate, for each sample.

   NOTE: The Contractor, as part of the mix design process, shall determine the exact proportion of lime. The lime content for coarse aggregate shall be 0.4 percent to 1.0 percent by mass of the dry aggregate sample and the lime content for fine aggregate shall be 1.5 percent to 2.0 percent by mass of the dry aggregate sample. The combined aggregate shall contain not less than 0.8 percent and not more than 1.5 percent lime by mass of dry aggregate. The amount of lime for open graded asphalt concrete may be reduced to between 0.5 percent and 1.0 percent.

3. Use a trowel or spoon to thoroughly mix the dry lime with the moisture-conditioned coarse aggregate samples.

4. Use a trowel or spoon to thoroughly mix the dry lime with the moisture-conditioned fine aggregate samples.

5. After mixing, place the lime-treated coarse and fine aggregate mixtures in separate containers to cure for a minimum of 24 hours and a maximum of 60 days.

6. After the lime-treated aggregates have marinated for at least 24 hours, combine the samples in accordance with California Test 304 and mix the composite blend thoroughly with a trowel or spoon.

   NOTE: Avoid segregation. Break up any lime balls or clods, as necessary.

   NOTE: The lime-treated aggregate shall marinate in the laboratory for not less than 24 hours and not more than 60 days.

7. Place the composite blend in a pan and oven-dry to constant weight at a temperature of 110 ±5°C and proceed with the mix design in accordance with California Test 304.

   NOTE: If fine particles or lime residue sticks to the pan after drying, use a short bristle brush to remove the particles or residue and recombine the material with the rest of the sample.

   NOTE: Aggregate shall not be re-treated with lime once it has been treated.

PRECAUTIONS

Hydrated lime is a fine powder. Extra care should be taken when working with lime. Adequate ventilation and the proper safety equipment should be utilized. Avoid contact with the skin and eyes, and avoid breathing contaminated air.

Prior to sampling, handling materials or testing, Caltrans personnel are required to read Part A (Section 5.0), Part B (Sections 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans Laboratory Safety Manual and the Materials Safety Data Sheets (MSDS) for all materials used.